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THE FUTURE OF MINERALOGY IN AMERICA[1]

INTRODUCTION

THIS meeting is the culmination of repeated efforts extending over a period of more than one hundred years to band the mineralogists of America together and to maintain a journal devoted primarily to mineralogy and cognate sciences. Although our colleagues in England and France organized over forty years ago, in 1876 and 1878, respectively, we were unable to do so until a year ago. The past year has been primarily one of adjustment and development and of bringing the need of such an organization more strongly to the attention of those interested. It has also been a period during which our ideas of what the society should be have become somewhat clarified. The progress made has been most gratifying. We are now a going concern with some very tangible assets, and there are already strong assurances of a most influential future. As retiring president, I desire to discuss briefly some of the important phases in the development of mineralogy in America, and the various efforts made to organize a national society, and to found a journal; also to interpret, if possible, the function of mineralogy in our present-day educational and scientific programs and to indicate some probable lines of future development.

THE PERIOD OF EARLY DEVELOPMENT, 1785–1850

The earliest published papers dealing with the mineralogy of America were apparently those which appeared in the *Memoirs of the American Academy of Arts and Sciences,* in 1785. These were followed two years later by

[1] Address of the retiring president of the Mineralogical Society of America, Chicago, December 29, 1920.

what Merrill characterizes as the first work on American geology although its title was distinctly mineralogical. I refer to Schoepf's *Beitraege zur Mineralogischen Kenntniss von des Oestlichen Theils von Nord Amerika und seine Gebirge,* which was published in Germany.

An event of far-reaching importance upon the development of our science was the appointment in 1802 of Benjamin Silliman as professor of chemistry, mineralogy, and so forth in Yale University. This appears to have been the first college appointment for mineralogy in America. Silliman began his lectures at Yale in the fall of 1804, and two years later wrote a sketch of the "Mineralogy of New Haven," which was published in 1810 in the *Transactions of the Connecticut Academy of Sciences.* In those days mineralogy and geology had not been sharply differentiated, and mineralogy was commonly used as the more comprehensive term. Accordingly, this contribution by Silliman is commonly recognized as the first attempt at a geological description of a region. Mention must also be made here of the "Mineralogical Observations made in the Environs of Boston in 1807 and 1808," by S. Godon, and which were published in the *Memoirs* of the American Academy of Arts and Sciences.

Interest in the subject was increasing rapidly so that in January, 1810, Dr. Archibald Bruce established the *American Mineralogical Journal,* the first American publication designed primarily for mineralogists and geologists. He was a native of New York City, having been born there in February, 1777. Although a physician by profession, Dr. Bruce was vitally interested in mineralogy. After completing his medical studies at the University of Edinburgh in 1800, he spent two years visiting important mineral localities and collections in England, France, Switzerland and Italy, so that when he returned to New York in the fall of 1803 to take up the practise of medicine he brought with him a mineral collection of great value.

Dr. Bruce's biographer tells us that

> the ruling passion in Dr. Bruce's mind was love of natural science and especially of mineralogy. Toward the study of this science, he produced in his own country a strong impulse, and he gave it no small degree of eclat. His cabinet, composed of very select and well characterized specimens; purchased by himself, or collected in his own pedestrian or other tours in Europe, or, in many instances, presented to him by distinguished mineralogists abroad; and both in its extent, and in relation to the then state of this country, very valuable, soon became an object of much attention. That of the late B. B. Perkins, which, at about the same time had been formed by Mr. Perkins in Europe, and imported by him into this country, was also placed in New York and both cabinets contributed more than any causes had ever done before to excite in the public mind an active interest in the science of mineralogy.

And further,

> Dr. Bruce manifested a strong desire to aid in bringing to light the neglected mineral treasures of the United States. He soon became a focus of information on these subjects. Specimens were sent to him from many and distant parts of the country, both as donations and for his opinion respecting their nature. In relation to mineralogy he conversed, he corresponded extensively, both with Europe and America; he performed mineralogical tours; he sought out and encouraged the young mineralogists of his own country, and often expressed a wish to see a journal of American mineralogy upon the plan of that of the School of Mines at Paris. This object, as is well known, he accomplished, and in 1810, published the first number of this work. Owing to extraneous causes, it was never carried beyond one volume; but it demonstrated the possibility of sustaining such a work in the United States, and will always be mentioned in the history of American science, as the earliest original purely scientific journal in America.

It is to be sincerely regretted that the failing health and early death of Bruce caused this journal to be so short-lived. Its continuation would have permitted the mineralogists of this country to have looked with pride upon the achievements of our early workers in this direction, for in Europe much progress in the founding of mineralogical journals had already been made. In France there was the *Journal des Mines,* founded in

1795 and which became the *Annales des Mines* in 1816. In Germany the *Taschenbuch fuer die gesammte Mineralogie mit Hinsicht auf die neuesten Endeckungen* was established in 1806, which subsequently was superseded by the *Zeitschrift fuer Mineralogie.* This journal in turn gave way to the *Jahrbuch fuer Mineralogie, Geognosie, Geologie, und Petrefaktenkunde* in 1830, which with but slight modifications in the title has continued down to the present day and is recognized as a most powerful influence in the development of the early sciences, especially in Europe.

The first comprehensive work on mineralogy in America was Parker Cleaveland's "Elementary Treatise on Mineralogy and Geology," a volume of 668 pages with numerous crystal drawings and a colored geological map of the eastern portion of the United States, which appeared in 1816. In writing this text it obviously was necessary for Cleaveland, who was professor of mathematics and natural philosophy, and lecturer on chemistry and mineralogy in Bowdoin College, to which position he had been appointed in 1805, to draw freely upon European writers, especially English, French and German. The incorporation of American localities was an arduous task, for Cleaveland indicates that Bruce's *Mineralogical Journal,* a paper by S. Godon in the *Memoirs of the American Academy,* and another by Dr. Adam Seybert, of Philadelphia, in the *Medical Museum* were almost the only printed authorities which he employed.

In his introduction, Cleaveland stresses the importance of mineralogy in the following manner:

> It may also be remarked that several arts and manufactures depend upon mineralogy for their existence; and that improvements and discoveries in the latter can not fail of extending their beneficial efforts to the aforementioned employments. In fine the study of mineralogy, whether it be viewed as tending to increase individual wealth, to improve and multiply arts and manufactures and thus promote the public good; or as affording a pleasant subject for scientific research, recommends itself to the attention of the citizen and scholar.

Also,

> But whatever progress may hitherto have been made in mineralogical pursuits, every new advance has opened a wider and more interesting prospect. The science is still in its infancy, and in many of its paths can only proceed with a faltering and uncertain step.

In reviewing this pioneer text, Professor Silliman in 1818 said:

> In our opinion, this work does honor to our country and will greatly promote the knowledge of mineralogy and geology, besides aiding in the great work of disseminating a taste for science generally. . . . The method of execution is masterly. Discrimination, perspicuity, judicious selection of characters and facts, a style chaste, manly, and comprehensive, are among the attributes of Professor Cleaveland's performance. . . . In our opinion, Professor Cleaveland's work ought to be introduced in all our schools of mineralogy and ought to be the travelling companion of every American mineralogist.

The text was received with great favor, a second edition in two volumes being issued in 1822. Although later a third edition became necessary, it was never prepared on account of the failing health of the author.

In 1825 Samuel Robinson published an elaborate list of American mineral localities, entitled "A catalogue of American minerals with their localities." The following year Emmon's "Manual of Mineralogy and Geology" was issued. This was a text of 230 pages. The part dealing with mineralogy was the second general treatise on mineralogy published in America. Little attention was given to crystallography. Descriptive mineralogy was emphasized and 297 minerals were described.

The next work on mineralogy by an American was the first part of the "Treatise on Mineralogy," published in 1832, by Professor C. U. Shepard, who at that time was an assistant to Professor Silliman at Yale University. It was based on the work of Mohs and was a small volume of 256 pages. This was followed in 1835 by Part Two consisting of two volumes of 630 pages. A second edition was published in 1844.

The year 1837 is memorable in the annals of American mineralogy on account of the publication in that year of Dana's "System of Mineralogy." While this work, consisting of 580 pages, was based to a considerable extent on the writings of European mineralogists, notably Haüy, Mohs, and Naumann, it was not devoid of originality. This is especially true of the section on mathematical crystallography and of the elaborate classification of minerals based upon the systems in use in botany and zoology. As it is well known, this system of classification gave way in the fourth edition, in 1854, to a chemical classification which has continued in quite general use down to the present time. Dana's "System of Mineralogy" was received with great favor, and the first edition was succeeded by others as follows: second in 1844, third in 1850, fourth in 1854, and fifth in 1868. The last edition, which is the sixth by E. S. Dana in 1892, with its various appendixes, is the standard reference work the world over on descriptive mineralogy.

As already indicated, in 1810 Bruce founded *The American Mineralogical Journal* which was discontinued after the publication of but one volume. Although but short-lived, it had demonstrated the great need of a strictly scientific journal. Consequently in 1817 Colonel George Gibbs, one of the most enthusiastic devotees of mineralogy and the possessor of perhaps the largest and most notable mineral collection in America at that time, which was purchased by Yale University in 1825, suggested to Professor Benjamin Silliman that a general scientific journal be established. This led to the founding of the *American Journal of Science* in 1818 under the editorship of Silliman. While its scope was intended "to embrace the circle of the physical sciences and their application to the arts, and to every useful purpose," the *American Journal of Science* has from the beginning published most of the important contributions on mineralogical subjects by American writers.

The decade 1810 to 1820 is an extremely important one to us, for during that period there were founded the *American Mineralogical Journal* and the *American Journal of Science*. There was also published Cleaveland's *Mineralogy*. However, it yet remains to call attention to the fact that in 1819 there was organized at Yale College the *American Geological Society*. Many of the members of this society can be characterized as mineralogists, and mention may be made in this connection of Gibbs, Silliman, Cleaveland and Godon. This organization continued until 1828, when it went out of existence. During this period, however, it did much to stimulate American workers in geology and mineralogy.

This organization was followed in 1840 by the *Association of American Geologists*, which held its first meeting in Philadelphia on April 2, 1840. Meetings were held annually and in 1843 the *Transactions of the Association of American Geologists and Naturalists* appeared. However, in 1847 this organization became the *American Association for the Advancement of Science*. It is thus seen that the American Association with which practically all the important scientific societies are now affiliated, was according to Alexander Winchell "in its incipiency a body of geologists, and its first constitution was prepared by geologists assembled in Boston, in 1847."

In the development of American higher education in the period prior to 1850, the fact must not be overlooked that no college or university considered itself adequately equipped unless it possessed a representative collection of minerals. Indeed in the case of some institutions mineral collections, or cabinets as they were commonly called, were usually among the first purchases authorized by the governing bodies of the institutions. Such was, for example, the case at the University of Michigan, which was founded on March 18, 1837, but was not formally opened for instruction until 1841. In the meantime, however, the well-selected mineral collection of Baron L. Lederer, of New York City, consisting of 2,600 specimens, mostly from foreign localities, was purchased. This admirable collection was moreover quickly augmented, so that when the university opened

its doors to students a collection of approximately 5,000 entries was available.

It will also be recalled that in 1807 Yale University acquired the Perkins collection, and that in 1825 the Gibbs collection also became the property of that institution. In discussing the growth of mineralogy in this country from 1818 to 1918, Ford says,

> There is no doubt but that the presence at this early date of this large and unusual mineral collection had a great influence upon the development of mineralogical science at Yale and in the country at large.

From the foregoing discussion it is quite obvious that mineralogy played a very important rôle in the development of higher education during the first half of the nineteenth century. It was one of the first sciences to find a place in the curricula of our colleges and universities. Its devotees founded the first general scientific journals, one of which has continued uninterruptedly up to the present time and is held in high esteem the world over. Mineralogists were also among the first to recognize the need and value of national organizations, and were important factors in the founding of our most general scientific society, the *American Association for the Advancement of Science.*

THE PERIOD OF EXPANSION, 1850–1900

The second half of the nineteenth century was a period of rapid development in higher education. Colleges and universities sprang up all over the United States in quick succession, especially in the mid and far west. It was also a period in which mineralogy and geology were applied practically on a very large scale by the federal and state surveys. The demand for competent geologists became very great, so that more emphasis was now placed upon geology than upon mineralogy by the institutions of higher learning. However, during the last two decades of the century the need of specialization became imperative and the number of scientifically trained mineralogists increased materially. It was during this period also that petrography and economic geology began to be recognized as independent disciplines.

Not only did the expansion of our surveys and the development of our vast mineral resources, but also the fostering of graduate work by our older and larger universities, demand adequately trained specialists. It will be recalled that during the eighties and early nineties comparatively large numbers of Americans went to Europe and especially to Germany, to acquire the latest methods in petrography and mineralogy.

After the *Association of American Geologists and Naturalists* in 1847 voted to resolve that organization into the *American Association for the Advancement of Science,* geology participated along with other sciences in the activities of the association, and with geography formed what is known as Section E. Although at first the *American Association* served the interests of the geologists rather satisfactorily, nevertheless with the rapid growth of the *Association* the opportunities for meetings of a strictly scientific character became fewer and the need of a separate organization began to be felt. According to Alexander Winchell an independent organization was first openly agitated by the geologists assembled at the meeting of the *American Association* at Cincinnati in 1881. Although a committee was appointed, which canvassed the situation and reported favorably upon the organization of a separate society and the establishment of a geological magazine, no definite action was taken at the next meeting.

However, this question continued to be considered quite regularly at successive annual meetings of the *Association* and the publication of the *American Geologist* was begun in Minneapolis in January, 1888. Again on August 14, 1888, in Cleveland, it was resolved that the formation of an *American Geological Society* was desirable, and organization plans were made. The first meeting was held in Ithaca on December 27, 1889, with a membership of 137. This organization, officially known as the *Geological Society of America,* was from the beginning independent and in no way subor-

dinate to the *American Association*. It at once became a great stimulus to American geology and has exerted profound influence upon its development.

During the last two decades of the nineteenth century the movement to band those interested in minerals together in local organizations manifested itself in several of our large cities. Thus in 1886 the *New York Mineralogical Club* was organized to "develop and maintain an interest in mineralogy, especially in the minerals and rocks of Manhattan Island, New York City, through collecting and the study and comparison of existing collections." The club has been successful in stimulating interest in mineralogy in New York City and its environs. It has also acquired the Chamberlain collection of minerals which is now deposited in the American Museum of Natural History. Reference must also be made of the fact that in 1892, what is known as the *Philadelphia Mineralogical Society*, was organized, its purpose being similar to that of the New York Club. From time to time similar organizations had been founded in other localities, all of which have done much to stimulate interest in minerals and especially of those of the region immediately surrounding the location of the society.

It was also during this period that a journal devoted to the interests of the lover of minerals was founded in 1885 by Mr. Arthur Chamberlain. It was first called the *Exchangers' Monthly* but was subsequently changed to the *Mineralogists' Monthly*. In 1892 *Goldthwaite's Minerals* was published. For two years both of these publications appeared but in 1894 they were merged into the *Mineral Collector*, which continued to appear regularly until March 1909 when it was discontinued.

THE MODERN PERIOD, 1900–1920

The first two decades of the twentieth century have been a period of enormous development in higher education. Attendance upon our colleges and universities has increased by leaps and bounds. The physical plants of these institutions were greatly extended. The older departments of instruction were materially expanded by the giving of more advanced and specialized courses, and many new departments were added. Our graduate work developed rapidly. Even before the outbreak of the World War, fewer and fewer students each year found it necessary to go to Europe, as had been the custom during the nineteenth century, for they were now able to secure the instruction desired in our universities. Indeed, this instruction could be obtained from equally competent men and in more modern laboratories with superior facilities than were to be found abroad. The many contributions by the various governmental bureaus and the establishment of the Geo-physical Laboratory in 1907 gave a great impetus to many branches of science in America. Industrial corporations also recognized the imperative need of adequately equipped laboratories and competent investigators.

During this period, the development of science was indeed marvelous. This statement applies to no science more than it does to mineralogy, by which term we obviously include what may be readily interpreted as the broader field, namely crystallography. Moreover, it was during the war that the preeminent position of the United States in the production of minerals and mineral products, and the vastness of our mineral resources were brought most forcibly to the attention of the general public. Mineralogical methods had to be resorted to in the solving of many special problems imposed by the war, when it became necessary for us to establish our scientific independence. Hence, at present the value of mineralogy is appreciated as never before. On account of its basic value in the training of the geologist, chemist, pharmacist, forester, mining engineer, ceramist, and many other specialized engineers and technologists, mineralogy has become in some of our larger and more progressive institutions what may be designated as a "service" science. Furthermore, it is no longer merely a descriptive science but by virtue of the development of many quantitative methods and especially as the re-

sult of the epoch-making discoveries in the field of crystal structure it is now an exact science of fundamental importance.

THE MINERALOGICAL SOCIETY OF AMERICA

During the first fifteen years of the existence of the *Geological Society of America,* comparatively few of its members were primarily interested in mineralogy. However, beginning with the latter half of the first decade of the twentieth century the number of professional mineralogists who became members of the society increased rapidly. This group, however, soon felt that aside from the social aspect of the meetings, the society offered them but little in their own field. Accordingly in January, 1913, Professor Alexander N. Winchell, of the University of Wisconsin, in a letter addressed to those especially interested in mineralogy and petrography, raised the question as to the advisability of organizing a *National Association of Mineralogists and Petrographers.* The responses were, however, of such a character that a postponement of a separate organization was decided upon. This question, however, would not be downed and it came up annually at the meetings of the *Geological Society of America,* so that finally at the Albany meeting, December, 1916, a small group consisting of Phillips, Van Horn, Walker, Wherry, Whitlock, and the speaker, decided to launch an active campaign looking toward the formation of the *Mineralogical Society of America.* A circular letter, signed by the above-named committee, was sent out to those most vitally interested and the replies received clearly indicated the great desirability of such an organization. However, the United States entered the World War in the following April, and consequently plans for organization were held in abeyance. But in the meantime, there had been much correspondence among those taking a lively interest in the organization, and in the fall of 1919 the new society was again actively agitated. A call was issued for an organization meeting to be held at the time of the meeting of the *Geological Society of America* in Boston, and on December 30, 1919, a group of 28 mineralogists met in the Mineralogical Museum of Harvard University and organized the society under whose auspices we are meeting to-day, and adopted a provisional constitution.

At this meeting arrangements were made whereby the lists of charter fellows and members would remain open for one year. The question of affiliation with the *Geological Society of America* was discussed and it is indeed gratifying to know that during the year this has been accomplished. On December 20, the *Mineralogical Society* had 55 fellows and 126 members. There were in addition 139 subscribers to the *American Mineralogist.* The most enthusiastic advocates of an independent mineralogical society never expected that such widespread interest could be stimulated during the organization year.

AMERICAN MINERALOGIST

As already indicated the *American Mineralogist,* which was founded in 1916, became the *Journal of the Mineralogical Society* under the editorship of one of the founders, Dr. E. T. Wherry. A board of associate editors was appointed by the council to assist Dr. Wherry. During the past year the *Journal* has appeared regularly, the earlier numbers being considerably larger in size than had previously been the case. However, on account of increased cost of paper and printing it was necessary to reduce the size of the later numbers. It is hoped that as a result of the general readjustment of prices the issuing of monthly numbers of from 24 to 32 pages each may soon become possible. The exact character of the *Journal* needs to receive the serious consideration of the council, inasmuch as it must serve the widely divergent interests of several groups of the society. We owe much to the energy, skill and unselfish devotion of our editor, who is constantly striving to make the *Journal* one of which American mineralogists may be justly proud. This, however, will require some little time and I trust that we may all be somewhat patient in this matter.

GENERAL OUTLOOK

As the result of a more general recognition of the basic importance of mineralogy in pure and applied science and in various branches of industry, and with a national society boasting of a membership including the progressive investigators and devotees of the subject, and with a well established and widely recognized official monthly publication, the future of mineralogy in America is assured. The problems of really fundamental significance requiring a comprehensive knowledge of crystallography and mineralogy are indeed many. The applications of the methods and truths of our science are constantly increasing and if America is to assume leadership in this great field it can be most speedily and advantageously accomplished through the friendly cooperation of the members of an organization such as this.

Edward H. Kraus

Mineralogical Laboratory,
University of Michigan

SEX IN THE TREMATODE FAMILY SCHISTOSOMIDÆ[1]

The trematode family Schistosomidæ in addition to containing three species which produce important human diseases, viz., *Schistosoma hæmatobium, S. mansoni,* and *S. japonicum,* is interesting because it is the only group of the trematodes in which the sexes are separate in the adult stage, which lives in the vertebrate. In this stage there is an extreme sexual dimorphism, the structure of the male being adapted for grasping the female in the gynæcophoric canal during copulation and the female having a very long slender body. The complete life cycles of the three human species of this family have been worked out in the last seven years, making it now possible to attack the problems related to the determination of sex and the development of sexual dimorphism.

Just what is involved in these problems can perhaps be made clear by a brief outline of the life cycle of one of the human species of this family, *Schistosoma japonicum.* The adult of this species lives in the bloodvessels of the liver and mesenteries of man and other mammals in the far East. The adults are almost always found in copulation in the vessels of the hepatic portal system. The fertilized ovum develops into the miracidium within the egg shell before the egg escapes from the host. The miracidium hatches almost immediately when the egg is voided into the water and dies within a short time unless it comes in contact with a small species of snail, *Blanfordia nosophora* (Robson). It penetrates vigorously into this snail and metamorphoses into a sac-like structure known as the mother sporocyst. The germ cells of the miracidium are carried over directly into the mother sporocyst and develop by parthenogenesis into daughter sporocysts. A single mother sporocyst may live for a considerable period of time and produce several hundred daughter sporocysts. These daughter sporocysts also carry germ cells and produce by parthenogenesis cercariæ which are the larvæ of the diœcious vertebrate-dwelling adults. These cercariæ escape into the water and will penetrate directly through the skin of any suitable host with which they come in contact. From the skin they make their way to the blood vessels of the liver, where they develop to sexual maturity in about three to four weeks. In fact I have seen copulation in an experimentally infested mouse nineteen days after exposure to these cercariæ.

The first question which naturally arises in connection with the sex phenomena in this life cycle is how far back can the sexual dimorphism be traced in the development of the adult from the cercaria in the final host. In a recent series of studies on the development of *Schistosoma japonicum* in experimentally infested mice I have been able to distinguish males from females in specimens about 0.3 mm. in length. Since the body of the cercaria of this species is about 0.15 mm. to 0.20 mm. in length and the smallest sexually mature forms have a length of about

[1] From the department of medical zoology of the school of hygiene and public health of the Johns Hopkins University.

4 mm. to 5 mm. it can be seen that the sexual dimorphism can be noted at a very early stage. Even in the smaller stages the males have a distinctly larger oral sucker than the females and the body is wider. Also early in development the females show a larger space between the intestinal ceca in front of their point of union than do the males. As development proceeds the differences in size between the suckers of the sexes becomes more distinct. The males become broad and flat and finally the sides of the post-acetabular region curl up to form the gynæcophoric canal. In the females the body tends to become round in cross section and the width is constantly much less than that of males of the same age. A detailed description of this development will be made in a future publication. Fujinami and Nakamura[2] in a paper published in Japanese antedate my findings on early sex dimorphism in *Schistosoma japonicum*. They were able to distinguish the sexes in specimens 0.5 mm. to 0.7 mm. in length, which developed in dogs. They laid especial emphasis on differences in the width of the body and in the character of the intestinal ceca as characters for distinguishing sex.

The next question which arises in this connection is whether sexual dimorphism is present in schistosome cercariæ. Although many workers have made studies and measurements of the cercariæ of the human schistosomes no one has reported such differences. I have myself examined a number of cercariæ of *S. japonicum* with this point especially in mind without noting any dimorphism. Dr. S. Yokogawa, of the Medical College of Formosa, also informs me that he has made an extensive series of examinations and measurements of this cercaria in an attempt to find sexual differences without success. Since the cercariæ of the human schistosomes are very small and can extend and contract their bodies to an unusual extent, slight size differences might escape notice in the living specimens and be difficult if not impossible to detect in measurements of preserved material.

Recently in some studies on a species of schistosome cercaria with eyespots from *Planorbis trivolvis* from Douglas Lake, Michigan, I have been able to demonstrate two distinct size types. This difference in size came to my attention first when I found that the curve plotted from the measurements of cercariæ from a number of infected snails was distinctly bimodal. More extensive studies showed that the cercariæ of this species fell into two distinct size groups. I further found from measurements of the cercariæ from eleven infested snails that in the cercariæ coming from a single snail only one of the size types was represented. The difference in size was so great between these two types that it could be recognized with the naked eye when free-swimming cercariæ of the two types were placed in separate bottles. Measurements of the length of the body of the larger type showed a range of variation from 0.234 mm. to 0.28 mm. while in the smaller type the range was from 0.207 mm. to 0.24 mm. Other measurements of the body and tail, which in this species is unusually large, showed like differences. The adult into which this cercaria develops is not known, although unsuccessful attempts were made to introduce it into ducks and rats. An analysis of its structure, however, places it near to the human schistosomes in the family Schistosomidæ. This relationship means that in all probability in the adult stage of this species the sexes are separate. I therefore interpret the size differences in this species of cercaria as a sexual dimorphism. If this view is accepted the fact that in one infested snail only one of the types of cercaria is represented immediately becomes very significant. A more detailed account of the dimorphism of this species of cercaria will be published later in connection with a study of its structure and activities.

In this connection must be cited the work of Tanabe,[3] on *Schistosoma japonicum*.

[2] Fujinami, A., and Nakamura, H., 1911, "A demonstration of some specimens showing the development of *Schistosoma japonicum*" (Japanese). *Bio ri Gaku Kaishi*, Vol. 1.

[3] Tanabe, K., 1919, "A contribution to the

This author found that in twenty-six out of thirty-one cases when the cercariæ from a single snail were used in infesting experimental animals all the individuals developed were of the same sex. Dr. S. Yokogawa has given me permission to use in this connection the results of some of his experiments along this line, which were performed several years ago. He found that when a cat, dog, or rabbit was infested with the cercariæ from a single snail that worms of only one sex would develop. He also found that in these cases the worms would not develop to maturity. These two workers have developed independently the same hypothesis to explain the results of these experiments.

According to this hypothesis sex in the schistosomes is determined in the fertilized egg and all the cercariæ coming from a single miracidium are of the same sex. When all the individuals derived from the cercariæ from a single snail were of the same sex it would follow that the infestation in this snail was from a single miracidium or two or more miracidia of the same sex. In those cases where both sexes came from the same snail, this snail must have been originally infested with two or more miracidia representing both sexes. Now my findings recorded above in regard to dimorphism in a species of schistosome cercaria, and the presence in one snail of only one of these types, lends further support to this hypothesis. Further, since in the life cycle of *S. japonicum,* the miracidium and the mother sporocyst are the only stages derived from a fertilized egg, it is in these stages that sex differentiation would theoretically be expected. Up to the present time, however, no one has examined these stages to determine whether they show a sexual dimorphism. My purpose in discussing the data given above and the hypothesis derived from them in this preliminary way is to call the attention of zoologists interested in the problems of sex to the interesting condition found in this trematode family.

WILLIAM W. CORT

knowledge of the morphology and development of *Schistosoma japonicum*'' (Japanese). An abstract of a paper given before the Japanese Pathological Society. *Igaku Chuo-Zashi,* Vol. 17, No. 6.

ORIGIN OF POTATO RUST[1]

A YEAR ago the writer called attention to the threatened introduction into the United States of two more crop pests, the potato rust, *Puccinia Pittieriana,* and the peanut rust, *Puccinia Arachidis.*[2] Since then the latter fungus has been found in one field in Florida, where all vestige of it was at once destroyed. The other fungus has not yet appeared in the United States.

During 1918 the potato rust was very abundant and harmful in the experiment station grounds at Ambato, Ecuador, not only upon potatoes but even more so on tomatoes. This was the first report of the rust in South America, having previously been known only from the high lands of Costa Rica on the potato alone. In Ecuador it showed decided preference for North American varieties of the tomato. An excellent illustrated account of the rust and its behavior, with conjectures on its origin, was published in the bulletin of the Ambato station for January, 1920, by the station botanist, Abelardo Pachano.[3] I take the liberty to quote a few disconnected sentences from this article, after changing them from the Spanish into an English garb.

The rust of the tomato and potato is a wholly new disease, not only in our fields [in Ecuador], but also elsewhere. Not simply the fact of its novelty should interest us, but more particularly its virulence, its ease of propagation, and the enormous injuries that it occasions; these considerations would seem to place it among the most serious maladies of cultivated crops.

The history of this rust [in this region] may be easily sketched. The year 1918 is demonstrated as the date of its first appearance. In fact in the spring of that year we had occasion to observe very grave disturbances, by our horticulturists given the general name of plague, in the tomato plots from seed of North American origin. The varieties most attacked were those by the names Acme, Golden Queen and Black-eyed State. Nearly at the same time we noted similar lesions

[1] Presented to the Mycological Section of the Botanical Society of America at the Chicago meeting, December 29, 1920.

[2] SCIENCE, 51: 246–247, March 5, 1920.

[3] *Boletin de Agricultura Quinta Normal,* 1: 7–12, Figs. 1, 2, January, 1920.

in the parcels of potatoes of the variety Calvache. But although the malady has increased very rapidly and is abundant in the tomato plots, it has not flourished in those of the potato.

Where did this new parasite come from? We have not met with it up to the present on any of our wild Solanaceæ, so as to enable us to infer that it has been transferred from them to the potato and tomato; neither has seed been received from Costa Rica so we could believe that it has come from that locality. The trouble, as it has manifested itself, has appeared on plots grown from North American seed, in a way to make us think that this new plague is to be referred to the United States.

Mr. Pachano informs me by letter that the disease was not so prominent during 1919 as it was in 1918, but had the same relative predominance on the tomato, especially on the North American varieties. He has also modified his views regarding its origin. We may assume, I think, that the susceptibility of North American varieties has no special significance in connection with the question of the native host or habitat. The snapdragon rust has been known since 1897, and has spread throughout the United States, but only recently has it been traced to its native Californian hosts. In fact I think we can safely assume that the appearance of the potato rust in the gardens of central Ecuador indicates that the rust can be found on uncultivated native plants in that same region. The Solanum rusts of tropical and semi-tropical America are numerous, but have been little studied, and those of Ecuador almost not at all.

There is a rust described from Colombia on *Sarache edulis*, a close relative of Solanum, which much resembles the potato rust except that it has slightly larger spores. This same rust on another species of Sarache was found in the vicinity of potato rust on Mt. Irazú in Costa Rica by E. W. D. Holway, who tells me that the plant is common in gardens there, going by the name "yerba mora." There is also a very similar rust known on the wild *Solanum triquetrum*, a vine ranging southward from central Texas into the adjacent region of Mexico, but this form has slightly smaller spores than the potato rust. Only actual trial can show if these forms can be transferred from one host to another, and if the size of the spores is in anywise dependent upon the host.

A variation in spore-size apparently dependent on the host is found to occur in the case of the snapdragon rust, and cases of such size variation are known for other species, some of them authenticated by pedigree cultures. The spores from the potato and tomato are remarkably uniform in size. Whether the three forms of Solanaceous rusts here referred to are the same or not, it is fairly safe to predict that the potato rust has originated somewhere between Ecuador and Costa Rica on hosts native to the localities.

J. C. ARTHUR

PURDUE UNIVERSITY,
LAFAYETTE, INDIANA

SCIENTIFIC EVENTS

A WORLD ATLAS OF COMMERCIAL GEOLOGY

WITH the growth of American industries the known and the possible sources of our supplies of raw materials have become of greater and more pressing interest. Even the United States—most favored of nations in abundance and variety of raw materials—can not be self-sufficient; it must look beyond its shores for supplies as well as for markets. The study of the distribution of mineral raw materials and their relations to the promotion of trade and the control of industry is a branch of geology and may best be termed commercial geology. Under the complex requirements of present-day life no continent, not even North America, can be self-sustaining. It is no longer enough for us to make an inventory of the mineral wealth of the United States; we must supplement that inventory by a broad understanding of world demand and supply. To set forth graphically and to describe concisely the basic facts concerning both the present and the future sources of the useful minerals is the purpose of a World Atlas of Commercial Geology just

issued by the United States Geological Survey, Department of the Interior.

The output of the essential minerals in 1913, the latest normal year, may at least be regarded as a measure of the "quick assets" possessed by each nation, and the first part of the World Atlas of Commercial Geology has therefore been planned to show the distribution of mineral production in 1913.

The practical value of this exhibit of the world's mineral assets is evident. Experience gained during the World War emphasizes the advantage of an adequate supply of raw materials close at hand, yet that there are certain economic limits to domestic independence in raw materials is clearly shown by the readjustments already made. The more facts we possess bearing upon the relative quantity and the relative availability of the mineral resources of our own and of other countries, the better able will be our captains of industry to decide whence they should derive their raw material. The mines of the United States should be looked upon primarily as tributary to the many mills, shops, and factories in which the skilled labor of the country may find its opportunity for a livelihood. The output of raw minerals measures only the first step in industry.

More than a score of geologists have cooperated in the preparation of this atlas, which was first undertaken during the World War as a part of the task of keeping American industries supplied with raw material and is to be regarded therefore as a by-product of the war-time activities of the Geological Survey.

AWARDS OF THE LOUTREUIL FOUNDATION OF THE PARIS ACADEMY

Among the awards made this year, as we learn from the report in *Nature*, are the following:

(1) 10,000 francs to Charles Alluaud and to R. Jeannel, for the study of the zoological and botanical material collected by them in the high mountains of eastern Africa and for the publication of the results.

(2) 5,000 francs to Jules Baillaud, for the establishment of a recording microphotometer of the type suggested in 1912 by P. Koch.

(3) 3,000 francs to Henry Bourget, director of the Marseilles Observatory, for the *Journal des Observateurs*.

(4) 2,000 francs to Clément Codron, for his researches on the sawing of metals.

(5) 5,000 francs to the School of Anthropology, for the publication of the *Revue d'Anthropologie*.

(6) 4,000 francs to Justin Jolly, for the publication of a work on blood and hæmatoporesis.

(7) 7,000 francs to Louis Joubin, for the publication of the results of the French Antarctic Expedition.

(8) 3,000 francs to the late Jules Laurent, for the publication (under the direction of Gaston Bonnier) of a work on the flora and geography of the neighborhood of Rheims.

(9) 3,000 francs to Henri Brocard and Léon Lemoyne, for the publication of the second and third volumes of their work entitled "Courbes géométriques remarquables planes et gauches."

(10) 2,000 francs to A. Menegaux, for the *Revue française d'Ornithologie*.

(11) 5,000 francs to Charles Nordmann, for his researches on stellar photometry.

(12) 8,000 francs to the Zi-Ka-Wei Observatory, in China (director, R. P. Gauthier), for recording time-signals from distant centers.

(13) 2,000 francs to O. Parent, for his studies on a group of Diptera.

(14) 10,000 francs to G. Pruvot and G. Racovitza, directors of the *Archives de Zoologie expérimentale et générale*, for this publication.

(15) 6,000 francs to Alcide Railliet, for the publication of researches on the parasites of the domestic animals of Indo-China.

(16) 4,000 francs to J. J. Rey, for the publication of a botanical geography of the Central Pyrenees.

(17) 10,000 francs to Maximilien Ringelmann, for researches relating to the physical and mechanical constants of metals intended to be used in the construction of agricultural machines.

(18) 12,000 francs to the Academy of Sciences, for the establishment of a catalogue of scientific and technical periodicals in the libraries of Paris.

It was pointed out by the council in 1917, that, although the special object of this foundation was the promotion of original research, up to that time requests for assisting work to be carried out according to a well-defined scheme had been exceedingly few in number.

THE AMERICAN JOURNAL OF TROPICAL MEDICINE

THE American Society of Tropical Medicine announces a new publication for physicians and research workers, to be known as *The American Journal of Tropical Medicine*. The announcement says:

"The general experience of the medical sciences has fully demonstrated the advantages which accrue from the segregation of special subjects. A central organ for the prompt presentation of articles, that are now scattered over a wide field, or the lack entirely of a proper medium to turn to for publication, will be a great convenience to those interested in the study of tropical diseases, and also serve to stimulate the growth and development of the subject. The purpose of the new JOURNAL will be to serve as a medium for the dissemination of reliable information from every source, with regard to the clinical and other phases of the nature, treatment, and prevention of tropical diseases."

The JOURNAL will be published bi-monthly by the Williams and Wilkins Company, Baltimore, Md. The transactions of the annual meetings of the American Society of Tropical Medicine will be published in the JOURNAL. Various reports, lists of members, and such other information as may be suitable will also appear. Other papers, whether from members or not, will also be published.

The following are members of the editorial staff:

Editor: H. J. Nichols, Medical Corps, U. S. Army, Army Medical School, Washington, D. C.; *Advisory Editorial Board:* B. K. Ashford, Medical Corps, U. S. Army, San Juan, Porto Rico; C. C. Bass, Tulane University, New Orleans, La.; M. F. Boyd, University of Texas, Galveston, Texas; C. F. Craig, Medical Corps, U. S. Army, Army Medical School, Washington, D. C.; George Dock, Washington University; Simon Flexner, Rockefeller Institute, New York City; William Krauss, Memphis, Tenn.; W. D. McCaw, Assistant Surgeon General, U. S. Army, Army Medical School, Washington, D. C.; G. W. McCoy, director, Hygienic Laboratory, U. S. P. H. S., Washington, D. C.; K. F. Meyer, University of California, San Francisco, Calif.; E. H. Ransom, Department of Agriculture, Washington, D. C.; R. P. Strong, Harvard University; A. J. Smith, University of Pennsylvania; E. R. Stitt, surgeon general, U. S. Navy; W. S. Thayer, Johns Hopkins University; E. J. Wood, Wilmington, N. C.; *Ex-officio Advisory Editorial Board, The American Society of Tropical Medicine:* J. M. Swan, president; K. F. Meyer, first vice-president; V. G. Heiser, second vice-president; S. K. Simon, secretary and treasurer; A. J. Smith, assistant secretary and treasurer; George Dock, councillor; C. L. Furbush, councillor; J. F. Siler, councillor; J. H. White, councillor; C. S. Butler, councillor.

THE SCIENTIFIC STAFF OF THE AMERICAN MUSEUM OF NATURAL HISTORY

IN appointing the scientific staff of the American Museum of Natural History for 1921, the board of trustees has made a number of changes and promotions, some of which have already been noted in SCIENCE. The senior curator of the staff, Dr. Joel A. Allen, has been promoted to be honorary curator of mammals, in order that he may devote his entire time to his researches. Dr. Allen is in his eighty-third year and for more than 35 years has been the head of the department of mammalogy. This relief from the responsibility of administrative work comes as a welcome change to Dr. Allen, who speaks of his new appointment in the following language:

> I wish to express to you, and through you to the board of trustees, my deep appreciation of this honor, and of the privileges accompanying it, thus awarded me. It will be a great solace to me during such time as may remain to me for the prosecution of research work, which I am still able to pursue with unabated zest and pleasure.

The trustees have created a new department designated as comparative anatomy and have appointed Dr. William K. Gregory to the curatorship as a recognition of Dr. Gregory's contributions to anatomy and vertebrate

paleontology, which have been largely carried on at the museum during the 22 years that he has been connected with it. Dr. Gregory will have associated with him in the new department Dr. J. Howard McGregor, who has been appointed associate in human anatomy.

The staff in ornithology, under the leadership of Dr. Frank M. Chapman, has been strengthened by the appointment of Dr. Robert Cushman Murphy as associate curator of marine birds. Dr. Murphy will devote himself particularly to the studies on the birds of the Brewster-Stanford Collection and to the collection which will be obtained by the Whitney South Sea Expedition

The former department of invertebrate zoology has been reorganized as two departments, namely, lower invertebrates and entomology. Dr. Henry E. Crampton has been appointed honorary curator of the new department of lower invertebrates and will confine his attention to his Polynesian researches. Mr. Roy W. Miner is appointed associate curator in charge.

Dr. Frank E. Lutz has been promoted to the curatorship of the new department of entomology.

Further staff changes or promotions are as follows:

PROMOTIONS

Lower Invertebrates: Willard G. Van Name, assistant to assistant curator.

Ornithology: Ludlow Griscom, assistant to assistant curator.

Anthropology: N. C. Nelson, assistant curator to associate curator of North American archeology; H. J. Spinden, assistant curator to associate curator of Mexican and Central American archeology.

NEW APPOINTMENTS

Comparative Anatomy: S. H. Chubb, assistant in osteology.

Public Education: Grace E. Fisher, assistant.

Ichthyology: E. W. Gudger, associate in ichthyology.

Mammalogy: Carl E. Akeley, associate in mammalogy.

Entomology: Herbert F. Schwarz, research associate, Hymenoptera.

The title of the department of physiology has been changed to read department of comparative physiology.

SCIENTIFIC NOTES AND NEWS

At a meeting of the trustees of the Elizabeth Thompson Science Fund, held on February 26, the following grants were voted: Dr. T. Brailsford Robertson, Adelaide, South Australia, $250 for the purchase of a comptometer for use in a statistical study of growth. Dr. Donald Macomber, Boston, $300 for an investigation of the effects of diet on fertility. Dr. W. J. Fisher, Woods Hole, $75 for a study of low sun phenomena (sunrise and sunset and horizon mirage). Dr. H. G. Barbour, New Haven, $300 for an investigation into the heat regulatory mechanism of the body.

Lawrence J. Henderson, professor of biological chemistry, has been appointed Harvard exchange professor to France and will lecture at the Sorbonne during the second half of the present academic year.

Professor William Alanson Bryan, formerly curator in the Bishop Museum and professor of zoology and geology in the University of Hawaii, has been appointed director of the Los Angeles Science Museum of History, and Art, where he succeeds the late Frank Dagget.

Dr. F. C. Harrison, principal of Macdonald College, was elected as president of the Society of American Bacteriologists, at their annual meeting held at Chicago.

At the annual meeting of the Royal Meteorological Society the following were elected officers: *President,* R. H. Hooker. *Vice-presidents,* J. Baxendell, W. W. Bryant, Sir Napier Shaw and Dr. E. M. Wedderburn. *Treasurer,* W. V. Graham. *Secretaries,* J. S. Dines, L. F. Richardson and G. Thomson.

During the current year the University of Texas established two lectureships to be filled by distinguished scholars from other universities. Professor E. G. Conklin, of Princeton University, was invited to Texas to fill the first engagement. During the week beginning February 28 Dr. Conklin gave a series of five

lectures, two to the general public and three seminar lectures to advanced students in the biological departments. Professor Conklin will also lecture at Houston, Galveston and San Antonio.

ON the evening of February 22, Professor F. R. Watson, of the University of Illinois, delivered an illustrated lecture on "Acoustics of auditoriums" before the Illinois Society of Architects at the Chicago Art Museum.

FREDERICK G. CLAPP, of New York City, an authority on petroleum geology, is giving a series of twelve lectures on that subject at Harvard University, beginning on Tuesday, March 8.

DR. HARLOW SHAPLEY, of the Mount Wilson Observatory, gave a series of illustrated lectures in San Francisco and Berkeley, February 25 and 27, on the following subjects: "New stars and variable stars," Astronomical Society of the Pacific, Native Sons' Hall, San Francisco; "On the structure of the galactic system," astronomical department of the University of California; "The dimensions of the sidereal universe," California Academy of Sciences, Golden Gate Park, San Francisco.

THE joint spring meeting of the Association of American Geographers and the American Geographical Society will be held in New York City on April 22 and 23. The complete program for the meeting will be published in the near future.

THE third annual meeting of the American Society of Mammalogists will be held in Washington, D. C., from May 2 to 4. Sessions devoted to the reading of papers, discussion and business, will be held from 10 A.M. to 4.30 P.M., each day, in the New National Museum. A session may also be arranged for the evening of May 2. Opportunities will be offered to visit various places of zoological interest in the city, and the usual social functions will be arranged.

THE annual meeting of the American Association of Pathologists and Bacteriologists will be held at Cleveland, Ohio, on March 25 and 26. Dr. Howard T. Karsner is the president.

THE next annual meeting of the American Astronomical Society will be held at the Van Vleck Observatory, Wesleyan University, Middletown, Connecticut, from August 30 to September 2, 1921.

THE second annual meeting of the Southwestern Geological Society will be held on March 18, at Tulsa, Oklahoma. The first bulletin of the society will be ready for distribution about that time. The society has a membership of one hundred and seventy-nine. Sections have been organized at Austin, Texas; Houston, Texas; Ardmore, Oklahoma; Okmulgee, Oklahoma; Duncan, Oklahoma; Dallas, Texas, and Shreveport, Louisiana. Visiting geologists in any of these localities are invited to attend the section meetings.

THE Indian Botanical Society has recently been organized with a charter membership of eighty-five. The officers, who serve until the meeting of January, 1922, are as follows: *President,* Winfield Dudgeon; *Vice-president,* W. Burns; *Secretary-treasurer,* Shiv Ram Kashyap; *Councilors,* Birbal Sahni and Rai Bahadur K. Rangachari. The society had its inception in a resolution passed by the Botanical Section of the Indian Science Congress at the Nagpur meeting in January, 1920.

THE Eye-Sight Conservation Council of America with headquarters in New York City, was recently organized, and Mr. L. W. Wallace, New York, was elected president, and Dr. Cassius D. Wescott, Chicago, vice-president. Drs. Frederick R. Green, Chicago; W. S. Rankin, Raleigh, N. C.; Arthur L. Day, Washington, D. C., and Allan J. McLaughlin, U. S. P. H. S., Washington, D. C., are members of the board of councilors. The council has for its object the conservation and improvement of vision by arousing public interest in eye hygiene, especially as it pertains to defective vision and the protection of the eyes in hazardous occupations.

THE trustees of the American Medical Association have made an appropriation to further meritorious research in subjects relating to scientific medicine and of practical interest to the medical profession, which might not be

carried out for lack of funds at hand. Applications for grants should be sent to the Committee on Scientific Research, American Medical Association, 535 North Dearborn Street, Chicago, before April 1, 1921, when action will be taken on the applications at hand.

Dr. J. Paul Goode (Minnesota, '89), of the department of geography of the University of Chicago, gave an address on "Coal and civilization" at the annual banquet of the General Alumni Association at the University of Minnestota, on February 18. The occasion was the fifty-third anniversary of the founding of the University of Minnesota.

Dr. S. B. Wolbach, associate professor of pathology and bacteriology, Harvard University, will deliver the eighth Harvey Society lecture at the New York Academy of Medicine on Saturday evening, March 12. His subject will be "Typhus fever and rickettsia."

Surgeon-General Ireland has completed plans to have prominent physicians of the country deliver addresses before the General Staff College at Washington. Dr. Joel E. Goldthwait, Boston, and Dr. Thomas W. Salmon, New York, recently went to Washington to speak at the college.

The Washington Section of the American Institute of Mining and Metallurgical Engineers held a supper and meeting at the Interior Department on January 14. Dr. H. Foster Bain, the newly appointed director of the Bureau of Mines, lectured on "Mines and mining in the far east."

On behalf of the subscribers to the Poynting Memorial Fund, the portrait of the late Professor J. H. Poynting by Mr. Bernard Munns has been presented to the University of Birmingham, and Mr. W. Waters Butler has presented the portrait of the late Professor Adrian Brown by the same artist.

Dr. William Miller Welch, an authority on contagious diseases, and for more than fifty years connected with the Philadelphia Bureau of Health, and professor in the graduate school of medicine of the University of Pennsylvania, has died at the age of eighty-three years.

Dr. F. J. V. Skiff, director of the Field Museum, Chicago, died on February 24 at the age of sixty-nine years.

The North Carolina Department of Agriculture announces the death of Dr. James Marion Pickel, for many years past the feed chemist of the department.

Dr. J. C. Cain, editor of the publications of the London Chemical Society and author of works on synthetic dyestuffs, died on January 31 at the age of fifty years.

Alfred Gabriel Nathorst, the eminent Swedish geologist and paleobotanist, died at Stockholm on January 20, in his seventy-first year.

Professor T. Miyake, of the department of zoology of the Agricultural College of the Imperial University of Tokyo, died on February 2 of typhoid fever which at that time was prevalent in Tokyo. Professor Miyake will be remembered as the author of a large two-volume work on the entomology of Japan, a review of which was published in Science some months ago.

The request is made to botanists to supply the department of botany of the Alabama Polytechnic Institute with separates and other publications to help restore the library which was lost in the fire which destroyed the agricultural building.

The sum of $500,000 has been given by Dr. Frank Schamberg, Dr. John A. Kolmer and Professor George M. Raiziss to the dermatological research laboratories of the University of Pennsylvania for the support of medical research. The sum represents the profits received by the laboratories during the war from the sale of the drug arsphenamine, a solution for German salvarsan. Its manufacture was the result of experiments conducted in the dermatological research laboratories by Dr. Schamberg and his two assistants, Dr. Kolmer, professor of pathology and bacteriology of the graduate school of medicine of the University of Pennsylvania, and George M. Raiziss, professor of chemotherapy at the same school of

the university. Dr. Schamberg was director of the Research Institute.

THE magnetic-survey yacht *Carnegie,* under the command of J. P. Ault, arrived at San Francisco on February 19. After re-outfitting there, she will continue her present circumnavigation cruise, which was begun at Washington in October, 1919, and has an aggregate length of about 62,000 nautical miles. She will cruise in the Pacific Ocean until about September and thence return via the Panama Canal to Washington in October.

PUBLIC lectures under the auspices of the New York City College Chemical Society, in the Doremus Lecture Theatre at four-thirty P.M. are announced as follows:

March 7. "Beyond the laboratory," Ellwood Hendrick.

March 15. "The service of the synthetic dye industry to the state," Marston Taylor Bogert, professor of chemistry at Columbia University.

March 23. "The trail of the chemist in the packing industry," Charles H. MacDowell, president, Armour Chemical Company.

April 8. "Explosives in war and peace," Ernest M. Symmes, Hercules Powder Co.

April 14. "Chemical evolution," Daniel D. Jackson, professor of chemical engineering at Columbia University.

THE Southwestern Division of the American Association for the Advancement of Science announces the following lectures at El Paso:

February 15. "How to live," Dr. Jenness.

March 1. "Alien insect enemies," Benjamin Druckermaur.

March 14. "The mechanism of heredity, development and evolution," Edwin Grant Conklin, of Princeton University.

March 15. "Historical progress in chemical theory," F. H. Seamon.

April 5. "Reclamation work," L. M. Lawson.

April 19. "Great American scientists: Major J. W. Powell and Professor Langley," E. C. Prentiss.

May 3. "Southwestern agricultural problems," Robert S. Trumbull.

May —. "Archæology," Edgar L. Hewett, of the School of American Research, Santa Fe, N. M.

May 17. "Crystallography," James C. Crichett.

UNIVERSITY AND EDUCATIONAL NEWS

BY the will of Miss Helen F. Massey a legacy of $500,000 has been left to the University of Pennsylvania. It is reported that one of the conditions of the bequest is that the income shall be used for increasing the salaries of members of the college faculty.

HAROLD HIBBERT, Ph.D., Sc.D., assistant professor in Yale University, has been promoted to an associate professorship of applied chemistry, and assigned to the graduate school and the Sheffield Scientific School.

DR. HUGH C. MULDOON, professor of chemistry at the Albany College of Pharmacy, has become dean and professor of chemistry in the School of Pharmacy, Valparaiso University.

THE biology department, Macdonald College, has been divided into two departments, the department of entomology and zoology, under Professor William Lochhead, and the department of botany, under Professor B. T. Dickson. Dr. G. P. McRostie, Ph.D. (Cornell, '17), has been appointed assistant professor in the cereal husbandry department in charge of grass and clover investigations, and Walter Biffen, B.Sc. (Wales '06), has been appointed lecturer in the department of botany.

DISCUSSION AND CORRESPONDENCE

MUSICAL NOTATION

TO THE EDITOR OF SCIENCE: While musical notation is not a matter of great scientific interest, reform presumably is.

The desirability of the changes advocated by Professors Huntington and Hall may be admitted. This leaves the space available for briefly discussing the cost.

The reform of printing implies (1) reprinting all existing music, and (2) scrapping some machinery, type, etc.

There is also an ideal cost. Whatever the exact methods of physical science may ultimately reveal as to the pitch in orchestral

playing, there is no question for instance that a succession of notes, G, G sharp, A and a succession G, A flat, A, are musically distinct, and that each actual sound on the piano is a symbol used to stand in turn for many musical entities. The reformed method would destroy the signs of some of these distinctions and reduce playing at sight to striking a succession of notes with little chance of prevision of the musical meaning.

As to the reformed keyboard there is again an obvious material if no clear ideal loss. However the judgment that the simplification of "physiological reflex" is of much value might be demurred to. One can conceive a psychologist taking the stand that a reflex is a reflex, and a musician saying that he had established the reflexes and forgotten the process. Finally we might have a violinist objecting to the pianist borrowing his G clef and returning it in a damaged condition, for advantages on the keyboard would be disadvantages on the fingerboard where the hand covers an octave diatonically and the accidentals are made by a special finger movement.

If musicians should bring forward these matters it must not be inferred that they are opposed to reform. On the contrary most of them desire it but can not meet the bill. The piano is no worse off than other instruments, probably better. A tenor trombone player in the ordinary week's work may have to read from music written in six or seven different systems, but the world rarely hears his complaints.

R. P. Baker

Iowa City, Iowa

MIRAGE AT SEA

To the Editor of Science: In the Sections reports of the meeting of the B. A. A. S., Bristol, 1875, p. 26, M. J. Janssen gave a brief summary of his observations and conclusions with regard to mirage at sea. As this happens to connect with a phase of low sun phenomena in which I am interested, and as I find no trace of any further publication by him, I would be glad to receive information as to whether he published further on this subject.

Willard J. Fisher

Woods Hole, Mass.

THE SIDEWALK MIRAGE

To the Editor of Science: My first experience with the sidewalk mirage described by Professor McNair in your issue of August 27, was on a smoothly paved straight-away between Canton and Alliance, Ohio. The time was three o'clock P.M. of a very hot day in August, 1918, the temperature being just about 100°. We were headed east on a level stretch, while about a mile ahead of us on a slightly higher level was a car apparently submerged in water to a depth of about two feet. A woman crossing the roadway was "in" up over her knees. As none of our party had ever seen such a reflection we got out of the car lest it might be caused by the windshield. At first the vision was lost until we discovered that the angle of vision was so small that we had to hunt for it, when it remained clear and distinct as long as we had the time to watch it.

Since that time I have seen a number of similar reflections, some in warm weather and others in cold; which leads me to conclude that heat is not necessary to produce them. The distance appears to govern the height from the ground as I have seen one within a distance of a square and it was within two or three inches of the surface. The surface reflection mentioned by Mr. Platt in your issue of September 27 is not uncommon, but could never be mistaken for the mirror-like surface of the mirage after you have seen a real one. Such explanations as I worked out in 1918 were upset the following winter and I shall watch with interest for further information that may be offered.

C. P. Du Shane

A RAINBOW AT NIGHT

To the Editor of Science: About 11 P.M. on Thursday, November 18, while waiting for a street car, I saw a clearly defined rainbow—a phenomenon which is possibly of sufficiently rare occurrence at night to be of interest to some of your readers.

A drizzling rain was falling overhead, but

stars were shining brightly to the north. The moon, which was very low in the west (about 15° south of west, with an altitude of some 5° or 6°), was hidden from view by buildings, where I stood; and, because of the street lights, I was not even aware that the moon was out until the rainbow in the east caught my eye. None of the prismatic colors could be detected, the bow being merely a yellowish arch of light very well defined at the southern end—rather an odd thing to see at that time of night.

FRANK L. GRIFFIN

REED COLLEGE,
PORTLAND, ORE.

SCIENTIFIC BOOKS

Gli Scienziati Italiani, dall'inizio del medio evo ai nostri giorni. Repertorio biobibliografico dei filosofii, matematici, astronomi, fisici, chimici, naturalisti, medici, e geografi Italiani. Diretto da ALDO MIELI, e compiuto con la collaborazione di numerosi scienziati, storici, e bibliografi. Vol. I., Parte I., Rome, 1921. Pp. viii + 236. A. Nardecchia, publisher.

In the issue of SCIENCE of August 30, 1919, pp. 213–214, I called attention to Italian activity in the field of the history of science, evidenced by the new publication *Archivio di Storia della Scienza,* edited by Aldo Mieli, which journal has now completed its first year. The present work indicates the continued and growing interest in Italy in the history of science.

The first part of this biographical dictionary presents the biographies of thirty-three Italian scientists from the fifteenth to the present century. The list of contributors to the volume shows that the great scholars of Italy are devoting themselves to assure the success of the present work under the able editorship of the distinguished historian of science, Aldo Mieli.

One peculiarity of the work is that neither chronological nor alphabetical order of treatment is pursued in selecting the scientists included. Eventually, of course, the completed work will be provided with all necessary indices. Each volume includes also the alphabetical index of names.

The order of treatment of each biography consists of the following: Life; Works, including a critical discussion of the historical and scientific significance; Bibliography, including complete catalogue of all works, with place and date of printing of published works, editions, and translations with precise bibliographical descriptions and also some statement of location in Italian libraries of volumes mentioned; Literature, giving lists of works which discuss the work or life of the scientist in question.

The mathematician will welcome the fine biographical statement (pp. 4–12) concerning Leonardo Fibonacci, written by Gino Loria; the astronomer will appreciate the excellent account (pp. 45–67) of Schiaparelli, by Elia Millosevich; the geographer and the astronomer will find much of interest in the account (pp. 101–111) of Giovanni Antonio Magini (1555–1617) by Antonio Favaro, who lists no less than 47 printed works (and editions) by Magini; the student of medical history, the botanist and naturalist and the physicist will enjoy a whole series of illuminating articles. Particularly noteworthy is the fact that a photograph and a facsimile of handwriting is given of each scientist, wherever possible.

This publication promises to be a work comparable only to the English Dictionary of National Biography; for America, France or Germany there is no work of this nature. When completed on present plans libraries will find it as indispensable as the above mentioned dictionary.

With the present state of exchange the price of 45 liras for Part I., viii plus 236 pages, is extremely low. Every effort should be made by American scientists, historians, and librarians to encourage the continuation of this publication on the present scale. The effective way to do this is by subscription to the publisher, A. Nardecchia, Via dell' Universita 11–14, Rome, Italy.

The alphabetical list of articles follows:

Acri, Francesco (1834–1913), philosopher, by E. P. Lamanna.

Alpino, Prospero (1553–1616) botanist, by A. Beguinot.

Amici, Giovanni Battista (1786–1863) physicist. naturalist, by G. B. De Toni.

Anguillara, Luigi (c. 1512–1570) botanist, by G. B. De Toni.

Baranzano, Redento (1590–1622) philosopher, astronomer, by G. Boffito.

Bertini, Anton Francesco (1658–1726), physician, by A. Corsini.

Bertini, Giuseppe (1772–1845) physician, by A. Corsini.

Bertini, Giuseppe Maria Saverio (1694–1756), physician, by A. Corsini.

Biringuccio, Vannoccio (1480–1530?), technician, chemist, by A. Mieli.

Cestoni, Diacinto (1637–1718), naturalist, by G. Stefanini.

Chiarugi, Vincenzo (1759–1820) psychiatrist, physician, by A. Vedrani.

Cocchi, Antonio (1695–1758), physician, by A. Corsini.

Corti, Bonaventura (1729–1813), botanist, by G. B. De Toni.

Cotugno, Domenico (1736–1822), physician, by G. Bilancioni.

De Visiani, Roberto (1800–1878), botanist, by A. Beguinot.

Dini, Ulisse (1845–1918), mathematician, by G. Loria.

Fibonacci, Leonardo (sec. xii–xiii), mathematician, by G. Loria.

Figari, Antonio (1804–1870) traveler, naturalist, by G. Stefanini.

Folli, Francesco (1624–1685), physician, naturalist, by G. Goretti-Miniati.

Ghini, Luca (c. 1490–1556), botanist, by G. B. De Toni.

Guilandino, Melchiorre (c. 1520–1589), botanist, by G. B. De Toni.

Inghirami, Giovanni (1779–1851), astronomer, by G. Giovannozzi.

Magini, Giovanni Antonio (1555-1617), astronomer, geographer, by A. Favaro.

Maranta, Bartolomeo (c. 1500–1511), physician, botanist, by G. B. De Toni.

Moletti, Giuseppe (1531–1588) astronomer, cosmographer, by A. Favaro.

Passerini, Giovanni (1816–1893), botanist, by G. B. De Toni.

Piccone, Antonio (1844–1901), botanist, by G. B. De Toni.

Pontedera, Giulio (1688–1737), botanist, by A. Beguinot.

Riva, Giovanni Guglielmo, (1627–1677), physician, by C. Artom.

Schiaparelli, Giovanni Virginio (1835–1910) astronomer, historian of science, by E. Millosevich.

Silvestri, Francesco (1474–1528), philosopher, by G. Sestili.

Sterzi, Giuseppe (1876–1919), anatomist, by G. Favaro.

Valli, Eusebio (1755–1816), physician, by A. Vedrani.

Zanardini, Giovanni (1804–1878), physician, botanist, by G. B. De Toni.

Louis C. Karpinski
University of Michigan

SPECIAL ARTICLES

THE EINSTEIN SOLAR FIELD AND SPACE OF SIX DIMENSIONS

The Einstein theory is four-dimensional in the sense that four (general or world) coordinates x_1, x_2, x_3, x_4 are employed. The fundamental quadratic form

$$ds^2 = \Sigma g_{ik} dx_i dx_k,$$

where the ten potentials g_{ik} are functions of the four coordinates, in general has a curvature tensor which does not vanish, and therefore defines a curved manifold M of four dimensions. In fact M is flat or euclidean or homodoidal only when there is no actual gravitation. Excluding this trivial case, the question arises what is the flat space of fewest dimensions n, which can be regarded as containing the curved manifold M?

Abstractly considered the possible values of n are 5, 6, 7, 8, 9, 10; that is, any M can surely be immersed in a flat space of not more than 10 dimensions. But if we take into account Einstein's differential equations of gravitation, $R_{ik} = 0$, or $G_{ik} = 0$, we find that the simplest case, $n = 5$, is actually impossible. That is to say:

An Einstein four-dimensional manifold, defining a permanent gravitational field, can never be regarded as immersed in a flat space of five dimensions.

This applies in particular to the solar field (defined say by the Schwarzschild form), in which the earth and the other planets are moving. The appropriate value of n must therefore be greater than 5 and less than 11. A brief discussion shows that actually $n = 6$. Therefore:

The solar gravitational field can be represented by a curved manifold of four dimensions situated in a flat space of six dimensions.

This manifold can be written in finite form and gives what may be called a *geometric model* of the field in which we are living.

The proofs of these theorems and the actual equation of this model are appearing in current numbers of the *American Journal of Mathematics*, together with the full discussion of the general results connecting light rays and orbits in any field stated in SCIENCE, October 29, 1920, pp. 413–414.

EDWARD KASNER

COLUMBIA UNIVERSITY

THE AMERICAN CHEMICAL SOCIETY

(Continued)

FERTILIZER DIVISION

F. B. Carpenter, *chairman*
H. C. Moore, *secretary*

Kelp as a basis of an American potash industry: J. W. TURRENTINE.

Relationships of chemistry and the fertilizer industry: C. H. MACDOWELL.

A perfect fertilizer law: E. G. PROULX.

Boron in relation to the fertilizer industry: J. E. BRECKENRIDGE.

The quantitative estimation of borax in mixed fertilizers: J. M. BARTLETT.

Note on the determination of nitrogen in fertilizers containing both organic and nitric nitrogen: F. B. CARPENTER. Notwithstanding the fact that the modified Kjeldahl and Gunning methods have been in use for a number of years, the results obtained by these methods in the hands of different analysts on samples containing mixtures of organic and nitric nitrogen are far from satisfactory. This is probably largely due to a wrong interpretation of the official method. From the standpoint of the manufacturer this is quite a serious matter and it seems desirable that the Association of Official Agricultural Chemists should take such action as is necessary to modify or at least change the reading of the modified methods so that there may be no misunderstanding of how they should be carried out.

Dicyanodiamide. A rapid, direct method for its determination in cyanamid and mixed fertilizers: ROLLA N. HARGER, presented by Oswald Schreiner. The method depends upon the fact that when a solution of silver picrate is added to a solution of dicyanodiamide, the latter is quantitatively precipitated as a double compound of silver picrate and dicyanodiamide, $C_6H_2(NO_2)_3OAG$, $C_2H_4N_4$. This new double compound we have named silver picrate-mono-cyanoguanidine. It forms in small crystals which quickly settle out of the solution and can be separated upon a Gooch crucible very rapidly, so that the analysis can be carried out in a very short time. Neither cyanide nor urea give any precipitate when their solutions are treated with silver picrate, and determinations of dicyanodiamide carried out in the presence of these compounds showed that they have no effect upon the analysis. The molar weight of the compound is 420.22, five (4.991) times that of dicyanodiamide, a fact which greatly enhances the accuracy of the method, since an error of 1 mg. in the precipitate weighed will mean an error of only 0.2 mg. of dicyanodiamide or 0.13+ mg. of nitrogen.

The changes taking place in cyanamid when used in mixed fertilizers: ROLLA N. HARGER, presented by Oswald Schreiner. (1) When cyanamid is placed in a mixed fertilizer containing acid phosphate and 5–10 per cent. of moisture, the cyanamide content decreases with great rapidity. (2) This change is represented principally by, and in many cases quantitatively by, the formation of dicyanodiamide. (3) A given quantity of moist acid phosphate is able to transform a limited amount of calcium cyanamid. (4) Cyanamid is not affected by dry acid phosphate. (5) Moisture alone is able to cause the conversion of cyanamid to dicyanodiamid, but the change is much slower than when acid phosphate is present. Since it has been repeatedly shown that dicyanodiamid is valueless as a fertilizer material and, moreover, is toxic to many plants, the formation of this compound in fertilizer materials seems undesirable. From the results of this study it would seem that

the method of applying cyanamid, commonly employed, which consists in adding the cyanamid to fertilizer mixtures containing acid phosphate, which mixtures almost always contain several per cent. of moisture, is a very questionable practise. Moreover, the use of cyanamid as a "conditioner" for "green" acid phosphate is very probably at the expense of most of the nitrogen in the cyanamid. On first thought it would appear that this conversion of cyanamid into dicyanodiamide could be avoided by simply employing dry fertilizer mixtures, but this overlooks the fact that when such mixtures are added to the soil moisture conditions are at once provided and the transformation may possibly then take place. Preliminary experiments carried out in this laboratory indicate that under certain conditions at least this is the case.

Some results of the determination of potash by the Lindo-Gladding method, using alcohol of various strengths in the presence of sodium salts: R. D. Caldwell and H. C. Moore. When potash is determined by the official method of the A. O. A. C. but slightly lower results are obtained when 80 per cent. alcohol is used than when 92 or 95 per cent. is used in case of sample of pure potassium chloride, but when sodium chloride or sulfate is added the results with 80 per cent. alcohol are lower. Tests with a sample of potassium platinic chloride showed it to be but slightly soluble in 80 per cent. alcohol alone, but the solubility increases with the increase of sodium salts added but with 95 per cent. alcohol sodium salts have no effect.

Injurious effects of borax on field crops: F. B. Carpenter. It has long been known that certain chemical substances are poisonous to plant life. While certain compounds of copper, zinc and arsenic are exceedingly poisonous, compounds of manganese and boron are far less deleterious. Most of the experiments which have been made with these compounds have been made on plants grown in pots or water cultures; in case of borax, however, considerable knowledge has been gained during the past few years on field crops from the use of Searles Lake potash, which contained an excessive amount of this compound. The first large scale borax poisoning in this country occurred in Indiana in 1917 on corn. In 1919 considerable damage was reported on potatoes and tobacco in different localities. Many conflicting reports were made in regard to amount of borax required to produce injury. While in some instances as little as two pounds per acre has been reported to have slightly injurious effects, one report was noted where as much as 400 pounds per acre was used with apparently no bad results. Experiments made by the writer on corn, beans, cotton, Irish potatoes, sweet potatoes and tobacco showed no bad effects where 8 pounds anhydrous borax per acre were used, but there was slight injury with sixteen pounds. It is evident, therefore, that the character of soil, amount and time of rainfall, the manner of application, etc., influence to a large degree the amount of borax which can be used without poisonous effect.

The "blank" in the Kjeldahl process; its analytical and commercial significance: B. F. Robertson.

Potash shales of Illinois: M. M. Austin and S. W. Parr. (1) Shales occur in at least two localities in Illinois which contain five per cent. or more of potash. (2) Shale outcropping in several places near Jonesboro in Union County which contain five per cent. of potash would be suitable, so far as can be determined from its chemical composition and physical character, for use in the manufacture of Portland cement. (3) By using this material in the manufacture of cement and by applying the known methods of potash recovery, a yield of 5.3 pounds of potash, representing a value of 70 to 80 cents per barrel of cement could be obtained. (4) The constitution of the southern Illinois shale is complex. The shale contains free oil, bituminous matter, pyrite, undecomposed potassium bearing rock, feldspathic in character and potassium bearing material of the nature of glauconite or greensand. (5) Shale from Dixon, Lee County, contains 5.8 per cent. of potash which is held for the most part in a more stable condition than that in the southern Illinois shale. (6) Extraction of the potassium from shale of either the southern Illinois or Dixon type by means of solid or liquid reagents would seem to be impracticable, because of the incomplete reaction of these reagents on the shale and because of the cost of leaching and recovering potash from material where it is present in such small amounts. (7) The plant availability of the potash in the southern Illinois shale is probably characteristic of all of the material of this type outcropping in that locality. (8) That part of the potassium in the southern Illinois shale which is soluble in sulphuric acid, is shown to be in a combination of the glauconite type. (9) In southern Illinois shale having a potash content of 5.0 per cent. in the raw condition or 5.6 per cent. when ignited, 62 per cent. of the total potash is glauconitic in character and is available as plant food.

Potash situation in Germany: H. A. Huston.

RUBBER DIVISION

W. K. Lewis, *chairman*

Arnold H. Smith, *secretary*

Reports.

Discussion: Shall the Rubber Division publish an annual volume of reprints and lengthy abstracts of everything of interest to the rubber chemist made public during the year?

Election of officers.

Rubber energy: W. B. WIEGAND. (Lantern.)

The aging of some rubber compounds: New Jersey Zinc Co. Research Laboratories. (Lantern.)

Some microsections cut from vulcanized rubber articles: New Jersey Zinc Co. Research Laboratories. (Lantern.)

The action of certain organic accelerators in the vulcanization of rubber. II.: G. D. KRATZ, A. H. FLOWER and B. J. SHAPIRO. The relative activities of molecularly equivalent amounts of aniline and diphenylthiourea in the acceleration of vulcanization were compared in rubber-sulfur mixtures and in mixtures which contained zinc oxide. In a rubber-sulfur mixture the activity of aniline was found to be much greater than that of diphenylthiourea. In mixtures which contained zinc oxide, the reverse was true. With aniline as the accelerator, either in the presence or absence of zinc oxide, the same maximum tensile strength was obtained, accompanied by a higher sulfur coefficient in the absence of zinc oxide than when this substance was present. The mixtures which contained zinc oxide, attained the same maximum tensile strengths at approximately the same sulfur coefficients, irrespective of whether aniline or diphenylthiourea was employed as the accelerator. It is evident that there is apparently no general relation between the physical properties and sulfur coefficients of accelerated mixtures.

The action of certain organic accelerators in the vulcanization of rubber. (II.): G. D. KRATZ, A. H. FLOWER and B. J. SHAPIRO. The activities of certain synthetic, nitrogenous organic accelerators, in a mixture of rubber and sulfur, were compared with the dissociation constants of the original substances. With the exception of members of a closely related series, no definite relation was found to exist between the activities of the substances as accelerators and their dissociation constants. Substances which decompose, or react, with other components of the mixture to form substances of acid character do not accelerate unless a neutralizing base, or salt, is present. The results obtained, and the conclusions drawn from them, compare favorably with other results obtained with ammonium salts.

Method for the determination of free sulfur and antimony tri- and penta-sulfides in golden antimony: J. F. SCHUFTER.

The action of heat and light on vulcanized rubber: J. B. TUTTLE. The action of heat and light on vulcanized rubber is frequently spoken of as being identical and oxidation is said to be the cause of the deterioration. From published and unpublished tests it is shown that the action of heat is one of change in the rate of the chemical reaction between rubber and sulfur and goes on throughout the entire mass, whereas the action of light is one of oxidation, taking place on the surface. Heat produces no change in the solubility of the rubber substance in solvents such as acetone and alcohol, whereas light breaks up the rubber molecule forming decomposition products which are readily soluble in acetone.

A theory of vulcanization based on the formation of polysulphides during vulcanization: WINFIELD SCOTT and C. W. BEDFORD. All organic accelerators and a number of inorganic accelerators function as catalysts of vulcanization through the formation of polysulphides. These accelerators may be placed into two classes: (1) Hydrogen sulphide polysulphide accelerators. Organic bases are believed to form polysulphides by the aid of hydrogen sulphide. Examples are piperidene and dimethylamine which form polysulphides in the presence of hydrogen sulphide and sulphur. Inorganic bases, such as sodium hydroxide, calcium hydrate, magnesium oxide and basic magnesium carbonate, function in the same manner as the above. (2) Carbo-sulph-hydrol polysulphide accelerators. Thio ureas and dithiocarbamates are believed to form some type of polysulphides through the grouping C-SH. Differentiated from the above two classes of accelerators are such accelerators as zinc oxide and litharge which do not form polysulphides. These are termed "secondary accelerators" owing to the fact that they decompose polysulphides to give active sulphur.

DIVISION OF WATER, SEWAGE AND SANITATION

J. W. Ellms, *chairman*

W. W. Skinner, *secretary*

Water softening for the manufacture of raw water ice: A. S. BEHRMAN. The manufacture of

ice from distilled water is rapidly being replaced by production of ice from raw water, due principally to cheap dependable power and water softening. The requisite characteristics of first quality ice are clearness, firmness and freedom from discoloration. In freezing water, by far the greatest part of the substances dissolved in it freeze out in the ice produced. Ice made from impure water is opaque, discolored and brittle, depending on the nature of the impurities. Lime-soda softening, followed by sand filtration, is the most efficient purification of raw water to be frozen. The most objectionable impurities are compounds of magnesium, calcium and iron, organic matter, silica and alumina, and sodium salts. Softening with lime eliminates temporary hardness, magnesium and iron, and reduces organic matter, silica and alumina. Recent investigations indicate that soda may be omitted from treatment, as removal of permanent hardness appears to be unimportant if all of magnesium is replaced by calcium. Temporary hardness is particularly objectionable, causing gritty white sediments in center of cake, white deposits in clear ice, weak structure, and probably crackings and also necessitates one or more core pumpings. Zeolite softening of the raw water has been shown to be unsuitable for ice making, due to the relatively large quantity of sodium salts which it leaves in the treated water to retard freezing and form deposits, to the fact that bicarbonates, which are in some manner connected with cracking, are not removed, and to the non-removal of iron, organic matter, alumina and silica.

Specifications for glassware for waterworks laboratories: Harry E. Jordan.

Hardness of surface waters in the United States: W. D. Collins.

The new sewage testing station of the Illinois State Water Survey Division: Edward Bartow. With the cooperation and assistance of the Sanitary Districts in Illinois, The State Water Survey Division has started again the sewage testing station that was operated from 1914–17 and in which work was practically discontinued during the war. It is proposed to test all processes of sewage disposal that may be applicable to Illinois conditions, as time and funds permit. The first test will be of the Dorr-Peck modification of the activated sludge process, which will be tested from raw sewage to clarified effluent and to dried sludge.

Charles L. Parsons,
Secretary

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION E—GEOLOGY AND GEOGRAPHY

Section E of the American Association for the Advancement of Science held its sessions this year in conjunction with the Geological Society of America and the Association of American Geographers, in Rosenwald Hall of the University of Chicago, from December 28 to January 1. In accordance with the agreement whereby the affiliated societies take charge of the program whenever they meet jointly with Section E, the Section had no program of its own. The address of the retiring vice-president, Dr. Charles Kenneth Leith, of the University of Wisconsin, upon the subject, "The structural failure of the lithosphere," was delivered on the evening of December 28 at the annual smoker of the Geological Society of America. It has been published in Science. The papers of the general sessions will appear in the *Bulletin of the Geological Society of America*, Vol. 32, and in the *Annals of the Association of American Geographers*, Vol. 11.

At the regular meeting of the Sectional Committee the following were nominated for sectional officers:

Vice-president and Chairman of the Section, Dr. Willet G. Miller, director of the Ontario Bureau of Mines.

Secretary for 4 Years, Dr. Elwood S. Moore, Pennsylvania State College.

The election of a committee member was not required this year.

Rollin T. Chamberlin,
Secretary

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